

WHAT IS CLAIMED IS:

1. A substantially flat heat transferring device, which includes a vaporization part where a liquid-phase coolant is vaporized and a condensing part where vapor generated in the vaporization part condenses into liquid, the liquid-phase coolant moving from the condensing part to the vaporization part by capillary force, the substantially flat heat transferring device comprising:

a lower plate, the bottom of which contacts a heat source;

an upper plate which is hermetically coupled with the lower plate along its edge to form a void therebetween;

a wick plate which is provided between the upper plate and the lower plate and is maintained in position relative to the lower plate by surface tension of the liquid-phase coolant; and

a liquid-phase coolant which transfers heat transferred from the heat source from the vaporization part to the condensing part circulating between the vaporization part and the condensing part,

wherein the wick plate includes a plurality of holes and a plurality of planar wicks and makes the liquid-phase coolant flow from the condensing part to the vaporization part by capillary force between itself and the lower plate.

2. The substantially flat heat transferring device of claim 1, a spacer plate which includes a plurality of spacers for maintaining a gap between the lower plate and the wick plate is further provided between the lower plate and the wick plate where the capillary force exists.

3. The substantially flat heat transferring device of claim 1, wherein protrusions facing the lower plate are formed on some of the planar wicks in order to uniformly maintain the gap between the lower plate and the wick plate.

4. The substantially flat heat transferring device of any of claims 1 through 3, wherein protrusions are formed at a surface of the upper plate facing the wick plate in order to maintain the wick plate in position relative to the lower plate.

5. The substantially flat heat transferring device of any of claims 1 through 3, wherein in order to maintain the wick plate in position relative to the lower plate, an elastic element is provided between the upper plate and the wick plate.

6. The substantially flat heat transferring device of claim 5, wherein the elastic element is a plate spring.

7. The substantially flat heat transferring device of any of claims 1 through 3, wherein the upper plate is embossed to have recessed parts and raised parts, and the recessed parts, which are parts raised toward the wick plate, of the upper plate contact some of the planar wicks to maintain the wick plate in position relative to the lower plate.

8. The substantially flat heat transferring device of any of claims 1 through 3, wherein the plurality of holes formed in the wick plate are arranged in straight lines, a radial pattern, or a mesh pattern so that the liquid-phase coolant can smoothly move.

9. The substantially flat heat transferring device of claim 4, wherein the plurality of holes formed in the wick plate are arranged in a straight-line pattern, a radial pattern, or a mesh pattern.

10. The substantially flat heat transferring device of claim 5, wherein the plurality of holes formed in the wick plate are arranged in a straight-line pattern, a radial pattern, or a mesh pattern.

11. The substantially flat heat transferring device of claim 7, wherein the plurality of holes formed in the wick plate are arranged in a straight-line pattern, a radial pattern, or a mesh pattern.

12. The substantially flat heat transferring device of any of claims 1 through 3, wherein a bridge is formed between at least some of the plurality of planar wicks.

13. The substantially flat heat transferring device of claim 4, wherein a bridge is formed between at least some of the plurality of planar wicks.

14. The substantially flat heat transferring device of claim 5, wherein a bridge is formed between at least some of the plurality of planar wicks.

15. The substantially flat heat transferring device of claim 7, wherein a bridge is formed between at least some of the plurality of planar wicks.

16. The substantially flat heat transferring device of claim 8, wherein if the plurality of holes are arranged in a straight-line pattern or a radial-pattern, a bridge is formed between at least some of the plurality of planar wicks.

17. The substantially flat heat transferring device of claim 2, wherein a bridge is formed between the plurality of spacers.

18. The substantially flat heat transferring device of claim 17, wherein protrusions are formed at an inner surface of the upper plate facing the wick plate in order to maintain the wick plate in position relative to the lower plate.

19. The substantially flat heat transferring device of claim 17, wherein in order to maintain the wick plate in position relative to the lower plate, an elastic element is provided between the upper plate and the wick plate so that the vapor generated in the vaporization part can smoothly move.

20. The substantially flat heat transferring device of claim 17, wherein the upper plate is embossed to have recessed parts and raised parts, and the recessed parts, which are parts raised toward the wick plate, of the upper plate contact some of the planar wicks.

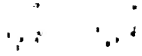
21. The substantially flat heat transferring device of claim 17, wherein the plurality of holes formed in the wick plate are arranged in a straight-line pattern, a radial pattern, or a mesh pattern.

22. The substantially flat heat transferring device of claim 21, wherein if the plurality of holes are arranged in a straight-line pattern or a radial pattern, a bridge is formed between at least some of the planar wicks.

23. The substantially flat heat transferring device of any of claims 1 through 3, wherein a heat sink is provided outside the condensing part for condensing the vapor.

24. The substantially flat heat transferring device of claim 4, wherein a heat sink is provided outside the condensing part for condensing the vapor.

25. The substantially flat heat transferring device of claim 5, wherein a heat sink is provided outside the condensing part for condensing the vapor.



26. The substantially flat heat transferring device of claim 7, wherein a heat sink is provided outside the condensing part for condensing the vapor.

27. The substantially flat heat transferring device of claim 8, wherein a heat sink is provided outside the condensing part for condensing the vapor.

28. The substantially flat heat transferring device of claim 23, wherein a bridge is formed between at least some of the plurality of planar wicks.

29. The substantially flat heat transferring device of claim 17, wherein a heat sink is provided outside the condensing part for condensing the vapor.

30. The substantially flat heat transferring device of any of claims 1 through 3, wherein the inside part of the lower plate which is not in contact with the upper plate is recessed to a predetermined depth.

31. The substantially flat heat transferring device of claim 4, wherein the inside part of the lower plate which is not in contact with the upper plate is recessed to a predetermined depth.

32. The substantially flat heat transferring device of claim 5, wherein the inside part of the lower plate which is not in contact with the upper plate is recessed to a predetermined depth.

33. The substantially flat heat transferring device of claim 7, wherein the inside part of the lower plate which is not in contact with the upper plate is recessed to a predetermined depth.

34. The substantially flat heat transferring device of claim 30, wherein the plurality of holes formed in the wick plate are arranged in a straight-line pattern, a radial pattern, or a mesh pattern.

35. The substantially flat heat transferring device of claim 34, wherein if the plurality of holes are arranged in a straight-line pattern or a radial pattern, a bridge is formed between at least some of the plurality of planar wicks.

36. The substantially flat heat transferring device of claim 17, wherein the inside part of the lower plate which is not in contact with the upper plate is recessed to a predetermined depth.

37. The substantially flat heat transferring device of claim 30, wherein a heat sink is provided outside the condensing part for condensing the vapor.

38. The substantially flat heat transferring device of claim 1, 2, or 3 further comprising vertical spacers, which are formed at the inner sidewalls of the upper plate to form a gap between the upper plate and elements surrounded by the upper plate.

39. The substantially flat heat transferring device of claim 4 further comprising vertical spacers, which are formed at the inner sidewalls of the upper plate to form a gap between the upper plate and elements surrounded by the upper plate.

40. The substantially flat heat transferring device of claim 4, wherein the protrusions are formed having a rectangular cross section, a circular cross section, or a polygonal cross section.

41. The substantially flat heat transferring device of claim 1, wherein the lower plate is a spacer integrated lower plate, which is formed by integrating the wick plate and the spacer protrusions, provided to maintain a uniform gap between the wick plate and the lower plate, into one body.

42. The substantially flat heat transferring device of claim 41 further comprising vertical spacers, which are formed at the inner sidewalls of the upper plate to form a gap between the upper plate and elements surrounded by the upper plate.

43. The substantially flat heat transferring device of claim 2, wherein the height of the spacer protrusions extending from the spacer integrated lower plate gradually decreases over the spacer integrated lower plate ranging from the condensing part to the vaporization part.

44. The substantially flat heat transferring device of claim 41, wherein the height of the spacer protrusions extending from the spacer integrated lower plate gradually decreases over the spacer integrated lower plate ranging from the condensing part to the vaporization part.

45. The substantially flat heat transferring device of any of claims 1 through 3, wherein protrusions, which contact the upper plate, are extended from the wick plate so as to make the wick plate firmly contact the lower plate.

46. The substantially flat heat transferring device of any of claims 1 through 3, wherein micropatterns are formed on the surface of the lower plate, having a smaller width than the planar wicks.

47. The substantially flat heat transferring device of claim 46, wherein the micropatterns are formed as grooves, isolated from one another with a predetermined distance thereamong.

48. The substantially flat heat transferring device of claim 38, wherein micropatterns are formed on the surface of the lower plate, having a smaller width than the planar wicks.

49. The substantially flat heat transferring device of claim 1 or 3, wherein a hydrophilic film is formed on the surface of the lower plate where the wick plate is to be mounted.

50. The substantially flat heat transferring device of claim 49, wherein the hydrophilic film is a porous film.

51. The substantially flat heat transferring device of claim 1, 2, 3, or 41, wherein at least either the upper or lower plate is composed of outer and inner covers of different materials.

52. The substantially flat heat transferring device of claim 38, wherein at least either the upper or lower plate is composed of outer and inner covers of different materials.

53. The substantially flat heat transferring device of claim 45, wherein at least either the upper or lower plate is composed of outer and inner covers of different materials.

54. The substantially flat heat transferring device of claim 1, wherein:

the heat transferring device has a length measured along the direction the liquid-phase coolant moves from the condensing part to the vaporization part, and a width measured perpendicular to the length along the lower plate; and

the width of the condensing part is greater than the width of the vaporization part.

55. The substantially flat heat transferring device of claim 1, wherein the plurality of planar wicks comprise:

first planar wicks extending in a straight line with a constant width from the vaporization part to the condensing part; and

second planar wicks which vary in direction and width from the vaporization part to the condensing part.

56. The substantially flat heat transferring device of claim 1, wherein the plurality of planar wicks comprise radial planar wicks extending in a radial directions from a center portion of the vaporization part.

57. The substantially flat heat transferring device of claim 2, wherein the plurality of spacers comprises:

first spacers extending in a parallel fashion from the vaporization part to the condensing part, spaced apart in the width direction by a first distance; and

second spacers extending parallel to the first spacers in the condensing part, separated from the first spacers in the width direction by a second distance which is greater than the first distance.

58. The substantially flat heat transferring device of claim 57, wherein the spacer plate further comprises a plurality of spacer plate bridges extending perpendicularly to the first and second spacers.

59. The substantially flat heat transferring device of claim 2, wherein the thickness of the plurality of wicks is greater than the thickness of the plurality of spacers.

60. The substantially flat heat transferring device of claim 2, wherein the height of the spacer protrusions extending from the spacer integrated lower plate decreases in discrete steps over the spacer integrated lower plate ranging from the condensing part to the vaporization part.

61. The substantially flat heat transferring device of claim 5, wherein the elastic element is a waveform spring extending in a width direction across the heat transferring device, and having a dimension in the length fraction small enough to prevent significant interference with the operation of the heat transferring device.

62. The substantially flat heat transferring device of claim 3, wherein the protrusions formed on some of the planar wicks and the planar wicks provide a T-shaped cross section.

63. The substantially flat heat transferring device of claim 7, wherein the embossed upper plate is embossed in a waveform shape.

64. The substantially flat heat transferring device of claim 63, wherein the waveform shape is a square wave.

65. The substantially flat heat transferring device of claim 20, wherein the embossed upper plate is embossed in a waveform shape.

66. The substantially flat heat transferring device of claim 65, wherein the waveform shape is a square waver.

67. The substantially flat heat transferring device of claim 12, wherein the bridge has a similar thickness than the plurality of planar wicks, and extends parallel to the lower plate.

68. The substantially flat heat transferring device of claim 12, wherein the bridge has a smaller thickness than the plurality of planar wicks, and extends parallel to the lower plate.

69. A method of fabricating a substantially flat heat transferring device which includes a vaporization part where a liquid-phase coolant is vaporized and a condensing part where vapor generated in the vaporization part condenses into liquid, the liquid-phase coolant moving from the condensing part to the vaporization part by capillary force, the method comprising:

- (1) forming a lower plate, the bottom surface of which contacts a heat source;
- (2) forming an upper plate corresponding to the lower plate so that a vapor moving space can be formed between elements mounted in the lower plate and the upper plate when coupling the lower plate with the upper plate;
- (3) forming a wick plate having a plurality of planar wicks and a plurality of holes for making the liquid-phase coolant move from the condensing part to the vaporization part;
- (4) mounting the wick plate in a predetermined region of the lower plate;
- (5) arranging the upper plate over the lower plate in which the wick plate is mounted;
- (6) coupling the upper plate with the lower plate; and
- (7) injecting a liquid-phase coolant between the coupled upper plate and the lower plate.

70. The method of claim 69, wherein in step (1), the predetermined region of the lower plate is recessed to a predetermined depth for installment of the wick plate.

71. The method of claim 69, wherein in step (3), wick plate protrusions are formed on the wick plate toward the upper plate so that they can be integrated into one body with the wick plate.

72. The method of claim 70, wherein in step (3), wick plate protrusions are formed on the wick plate toward the upper plate so that they can be integrated into one body with the wick plate.

73. The method of claim 69, wherein in step (2), protrusions are formed at one among parts of the upper plate corresponding to the vaporization part and the condensing part so as to maintain the wick plate in position relative to the lower plate.

74. The method of claim 69 further comprising forming a spacer plate having a plurality of spacers for uniformly maintaining a gap between the wick plate and the lower plate and installing the spacer plate between the wick plate and the lower plate.

75. The method of claim 74, wherein the plurality of spacers have a gradually decreasing height so that their height is larger in the condensing part than in the vaporization part.

76. The method of claim 69 further comprising forming an elastic element for maintaining the wick plate in position relative to the lower plate and installing the elastic element between the upper plate and the wick plate.

77. The method of any of claims 69 through 76, wherein in the formation of the wick plate, a bridge is formed between at least some of the plurality of planar wicks.

78. The method of any of claims 69 through 73, wherein protrusions are formed at an inner surface facing the lower plate of one selected from the planar wicks.

79. The method of claim 74, wherein a spacer bridge is formed between at least some of the plurality of spacers.

80. The method of claim 69, wherein in step (3), the plurality of planar wicks or the plurality of holes are formed using wet etching, dry etching, or punching.

81. The method of claim 69, wherein in step (6), the upper and lower plates are coupled using welding, brazing, electrostatic coupling, or thermal coupling.

82. The method of claim 69, wherein the plurality of planar wicks or holes are arranged in a straight-line pattern, a radial pattern, or a mesh pattern.

83. The method of claim 69, wherein the upper plate corresponding to the vaporization part and the condensing part is embossed to have recessed regions and raised regions so that the vapor can smoothly move and the recessed regions protruded toward the wick plate contact at least some of the plurality of planar wicks.

84. The method of claim 69, wherein in step (1), micropatterns are formed on the surface of the lower plate so as to expand the surface area of the lower plate.

85. The method of claim 69, wherein spacer protrusions are formed on the lower plate, protruding upward so that they can be integrated into one body with the lower plate.

86. The method of claim 85, wherein the height of spacer protrusions gradually decreases over the lower plate ranging from the condensing part to the vaporization part.

87. The method of claim 69, wherein a region of the lower plate on which the wick plate is to be mounted is covered with a hydrophilic film before mounting the wick plate on the lower plate.

88. The method of claim 87, wherein the hydrophilic film is a porous film.

*

89. The method of claim 69, wherein in step (2), vertical spacers are formed at the inner sidewalls of the upper plate so as to form a gap between the upper plate and the wick plate.

90. The method of claim 73, wherein the protrusions are formed having a rectangular cross section, a circular cross section, or a polygonal cross sectional.

91. The method of claim 69 further comprising forming a material layer of a different material from the material of the upper plate on the inner surface of the upper plate.

92. The method of claim 69 or 91 further comprising forming a material layer of a different material from the material of the lower plate on the entire surface of the lower plate, facing the upper plate.